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DEVELOPMENT AND CHARACTERIZATION OF A MINIATURIZED HALL-EFFECT THRUSTER FOR SMALL SATELLITES

Abstract

The increasing demand for small satellites, particularly CubeSats, has driven the need for efficient and miniaturized electric propulsion systems. These systems play a crucial role in enabling precise orbital maneuvers, station keeping, and controlled de-orbiting while adhering to the strict power and volume constraints of small satellite platforms. To address this need, BERLIN SPACE has developed the HET-2, a 2-mN Hall-effect thruster, optimized for integration into small satellite architectures.

The HET-2 thruster employs an optimized magnetic field topology to enhance efficiency, while its cathode and anode design improve both ignition performance and thruster lifetime. The system operates on Xenon and Krypton propellants, providing a specific impulse of 830 s within a power range of 60-80 W. To evaluate its performance, extensive testing is conducted at BERLIN SPACE and Technical University of Dresden, including thrust measurements and beam divergence characterization.

The preliminary design of HET-2 has been optimized to meet the stringent requirements of small satellite propulsion. Initial test results demonstrate stable thrust generation with minimal performance degradation. Further optimization will focus on achieving the smallest possible design while maximizing efficiency and overcoming miniaturization challenges such as lifetime limitations and magnetic field stability. These refinements will ensure the system meets both technical and operational mission requirements.

The HET-2 propulsion system represents a significant advancement in miniaturized electric propulsion technology. With its compact form factor, high thrust efficiency, and extended operational lifetime, it provides a cost-effective and scalable propulsion solution for future CubeSat missions. By addressing the key challenges of power efficiency, lifetime, and miniaturization, this system supports the growing need for advanced propulsion in commercial, academic, and scientific satellite applications.